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AGASSIZ ON RECENT FISHES.

DAVID STARR JORDAN.

About 1827, when Louis Agassiz was some twenty years of age, a student in the University of Munich, Spix and Martius returned from their travels in Brazil, bringing with them a large collection of fishes.

Agassiz was then a favored student of Dr. Döllinger, resident in his house, where in his modest apartments he maintained his "little academy," "sleeping-room, fencing-room, museum, and laboratory all in one," and here he kept the collection of fish skeletons which the anatomist Meckel once came all the way to Munich to see. He had already studied the structure and breeding habits of the fishes of Lake Neuchâtel, and his reputation was established as a man that knows fishes.

The collection of Spix and Martius was placed in Agassiz's hands, to be treated according to the best methods of systematic zoology. This the young man did to the best of his ability, taking the classic writings of Bloch and Lacépède as his model, and doing with his material quite as well as these fathers of ichthyology could have done.

The *Piscium Brasiliensium*, published in 1829, made a large, thick quarto, on heavy paper, with detailed descriptions and colored full-page illustrations of each species. The engravings were poor and costly, after the fashion of the time, and the descriptions elaborate, but uncritical, being formed after bad models before good models existed.

Criticism and comparison in zoology was first introduced by Cuvier, and most of Cuvier's descriptive work was in 1827 still in the future, though numerous references in the text to letters from Cuvier show that Agassiz had tried to make the best use he could of the help of his master.

A number of papers on the fresh-water fishes of Switzerland and neighboring regions were published in following years, —

worthy fruits of Agassiz's professorship in Neuchâtel. Those on the Salmonidæ treated largely of problems of development, at once most difficult and most interesting. Others took up the classification of the complicated family of Cyprinidæ (carp, chubs, dace, and minnows), with an attempt to divide the group into genera founded on natural — that is, anatomical — characters.

Similar attempts were made at about the same time by John J. Heckel and by Charles Lucien Bonaparte with much the same results. On the whole, Agassiz's work was the more successful as well as earlier in time.

For a number of years the fossil fishes and the glaciers occupied most of Agassiz's scientific activity.

In 1846 he came to America, accepting a chair in Harvard College, and was soon engaged in exploring the natural products of the New World, to which he "came in the spirit of adventure and curiosity," and in which he stayed "because he liked the land where he could think and act as he pleased; the land where nature was rich, while tools and workmen were few, and traditions none."

In America he soon renewed his interest in the fishes. In 1850 he published his volume on Lake Superior, which contained among other things an account of the fishes collected by himself and his students in a summer's trip of exploration.

In this volume, which is accompanied by excellent stone engravings, we see more of Agassiz's tendency to philosophic discussion. A remarkable new species, Percopsis, the type of a new family of ancient lineage, suggests to him many thoughts as to the succession of forms among fishes, though he was still unprepared to see in this a genetic relation. The descriptions of species in this book are very detailed, but not at all critical. They seem like the work of students, as they doubtless were, for whoever was in Agassiz's company was always set to work along the line of his thoughts. Agassiz's own best work was not in the line of description, but rather in suggestion. He had a keen eye for generalization, as for comparison and classification. His later papers on fishes were of the nature of syllabi and suggestions rather than of finished work, but they play a very large part in the history of the systematic zoology of North America.

One of the most important of these was a critical study of the fauna of the Tennessee River, published in 1854, and based chiefly on collections made by Mr. Newman at Huntsville, Ala. In this paper he discussed certain problems of the distribution of fresh waters and indicated new ones. If he had answered these by inductive observation, he would have been led, as his students have been, at once into the belief in the transmutation of species.

In 1855 a collection of fishes from the western parts of the United States led him to a consideration in detail of the proper classification of our fresh-water fishes. Most of the many genera here proposed by him have stood the test of time, but in a few cases the true relation of forms was not fully understood. At about the same time, Dr. A. C. Jackson, of San Diego, called the attention of Professor Agassiz to the group of viviparous surf fishes (Embiotocidæ) which constitutes the most remarkable feature of the fish fauna of California. Agassiz took up the study of this group, described many of its genera and species, and gave an interesting account of its remarkable anatomical features. At almost the same time the same peculiarities were independently studied by Dr. W. O. Gibbons, of Alameda, and by Dr. Charles Girard, of the Smithsonian Institution, himself one of Agassiz's students. Agassiz's papers have priority of date, and the generic names given by him, especially the type name of Embiotoca, this word an inspiration in itself, are in general the ones to be retained.

After 1855 no papers of importance relating to fishes were published under Agassiz's own name. We find the influence of his views and example in the work of his students, notably Girard, Putnam, and Garman, as well as in that of Baird, Storer, and others who were indebted to him in one way or another for assistance.

Concerning the vast wealth of his Brazilian and other South American collections, Agassiz has written little. The basement of the museum at Cambridge is still crowded with unstudied material collected by Agassiz. Much of this material has been investigated by Steindachner, Garman, Eigenmann, and the present writer, but with all that has been done there remains a residue rich in undescribed species.

Although the study of recent fishes was only a minor incident in Agassiz's multifarious activities, it was a branch in which he felt the deepest interest. His keen and broad insight helped him to bring its chaos into order, and his name deserves a large place in the history of systematic ichthyology.

With all his acumen, Agassiz was never able to correctly interpret the facts of the succession of the fishes. He said to me in 1873: "At one time (about 1842) I was on the verge of anticipating Darwinism, but I made up my mind at last that progress by transmutation of species could not be, because we had our highest fishes first."

Of course this is true in a sense, because the ganoid fishes are beyond a doubt nearer to the higher vertebrates than the recent fishes are, and the early sharks are in some regards (brain, reproductive system, alimentary canal, and teeth) more highly developed than is the case with the true or modern fishes. But neither of these facts, as we now understand, bears on the real question. The ganoid fishes constitute a synthetic or generalized type, from which at least two great lines of descent have sprung. From the double-breathing or amphibious ganoids we have descended the Batrachia, who pass through the fish-like or water-breathing stage as a phase of youth. From these come the Reptilia, who pass through their fish-like stage in embryo. And from Reptilia come the warm-blooded mammals and birds. The other great line of descent remains aquatic and fish-like. Its line of specialization has been to make its members more and more intensely *fish*. The purely aquatic life demands not higher development, but adaptive or "fish-like" structure. The typical recent fish loses its amphibian possibilities very early in life, and its development is along the lines of the demands its fish life is to make. In the abstract a modern fish is not "higher" than its ancient ganoid ancestors; nor is it properly in most respects lower. It has diverged and is become specialized and adapted to its condition in life. Adaptation, not progress, is the meaning of organic evolution.